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(54) Discharging fire and explosion suppressants

(57) A nozzle unit (4) for discharging and atomising a fire or explosion suppressant, comprises a rigid-walled cylindrical container (5) having a nozzle portion (20) at one end with radially directed discharge orifices (22). A barrier having rupturable discs (100,102) normally blocks the nozzle portion (20) from the interior (56) of the container. At the other end of the container, a piston (106) is positioned so as to be sealingly slidable along the container in response to pressure generated by a gas pressure generator (6). The moving piston (106) pressurises the suppressant agent within the hollow interior (56) until the rupturable discs (100,102) burst. The suppressant agent is accelerated substantially instantaneously and discharged in atomised form through the discharge orifices (22). The gas pressure generator (6) may be a pyrotechnic gas generator. Some of the heated gas is diverted into direct contact with the suppressant immediately before it is discharged via a bore (104), so as to heat and vaporize the discharging suppressant.

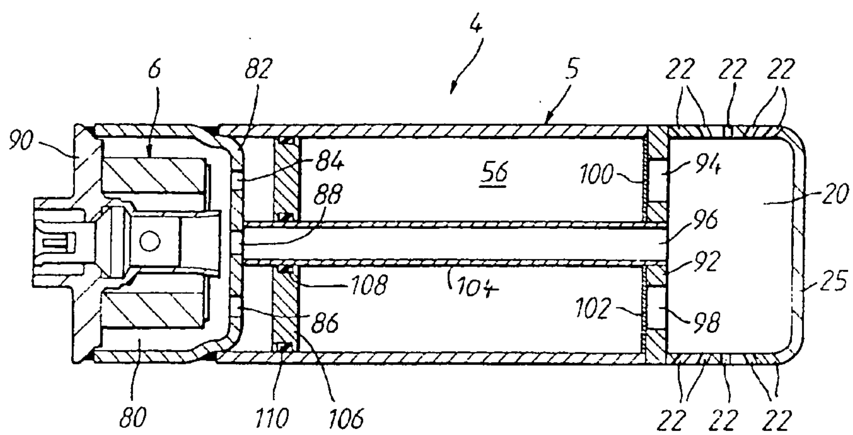

Fig.1

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Description

The invention relates to apparatus for discharging a fire or explosion suppressant, comprising discharge nozzle means, storing means for storing the suppressant juxtaposed with the nozzle means, and discharge means for applying gas pressure to the stored suppressant without contact between the gas pressure and the suppressant to discharge it through the nozzle means.

The invention also relates to apparatus for discharging a fire or explosion suppression agent, comprising a rigid-walled container having a hollow interior, nozzle means providing a discharge orifice mounted on the container, means within the container defining an enclosure therein for receiving the suppressant agent, the means defining the enclosure including a rupturable barrier normally blocking the interior of the enclosure from the nozzle means, the means defining the enclosure including movable wall means within the enclosure and gas producing means for generating gas pressure within a region of the container separated from the enclosure by the movable wall means whereby the movable wall means moves in response to the gas pressure to compress the suppressant agent within the enclosure until the rupturable barrier ruptures and the suppressant agent is forcibly discharged through the nozzle means.

Such apparatus is known from US-A-3 401 750. It is desirable, however, to improve the effectiveness of the suppressant.

Accordingly, the apparatus as first set forth above is characterised by heating means operative to apply heat to the pressurised suppressant, whereby to cause at least partial vaporisation of the discharged suppressant.

In addition, the apparatus as secondly set forth above is characterised in that the gas producing means produces the gas under pressure and at high temperature, and by means for bypassing the movable means and supplying part, only, of the high temperature gas to the discharging suppressant to heat it.

Apparatus embodying the invention, and for discharging fire and explosion suppressant materials, will now be described, by way of example only, with reference to the accompanying diagrammatic drawings in which:

Figure 1 is a longitudinal section through one form of the apparatus;

Figure 2 is a longitudinal section of part of a modified form of the apparatus of Figure 1 to an enlarged scale; and

Figure 3 is a schematic view of a system incorporating the apparatus of Figure 1.

As shown in Figure 1, the apparatus 4 comprises a cylindrical casing 5 made of suitable material to withstand the high pressures developed within it in use (as will be explained).

At one end of the chamber, a pressure generator 6 is mounted. The pressure generator may take any suitable form. Known forms of suitable pressure generator comprise pyrotechnic pressure generators of the azide type such as disclosed in United Kingdom Patent Specification No. 2174179. Alternatively, the pressure generator 6 could be of the explosive or cordite type. In either case, the pressure generator incorporates an igniter which, when electrically energised, causes the pressure generator to generate a high gas pressure very rapidly within the interior of a sub-chamber 80 which is divided from the remainder of the interior of the casing 5 by a wall 82. The wall 82 is apertured at 84,86 and 88. An end wall 90 closes off the adjacent end of the casing 5.

At the end of the casing 5 opposite to the pressure generator 6, an end portion 20 is provided. It is closed off by an end wall 25 and defines apertures 22 in the adjacent side wall of the casing. A dividing wall 92 closes off the end portion 20 from a central interior portion 56 of the casing 5. The wall 92 is provided with apertures 94,96 and 98. Apertures 94 and 98 are closed off from the interior 56 of the casing 5 by rupturable discs 100 and 102.

A solid tube 104 extends through the interior 56 of the casing 5, from the wall 82 to the wall 92, this tube thus connecting the aperture 88 with the aperture 96.

The apparatus is provided with a piston 106. The piston 106 slides on the outside of the tube 104 and is sealed to it by a sealing ring 108. The periphery of the piston 106 is sealed to the interior wall of the casing 5 by a seal 110.

The central interior space 56 is charged with the extinguishant material. For example, this material may be an extinguishant sold by Great Lakes Chemical Corporation under the designation FM-200. However, any other suitable suppressant may be used, preferably one having zero ozone depletion potential (ODP) such as a suitable dry powder or water. The suppressant may be pumped into the interior 56 through a suitable fill tube (not shown). The pressure of the suppressant within the interior 56 forces the piston 106 to the left as shown in the Figure.

In use, ignition of the gas generator 6 generates hot gas, producing a very rapid pressure increase within chamber 80. The gas pressure is exerted on the left hand face (as viewed in Figure 1) of piston 106 through apertures 84 and 86, thus moving the piston 106 to the right. The suppressant is therefore compressed within the volume 56 until the rupturable discs 100 and 102 burst. The compressed suppressant is thus rapidly ejected through the apertures 94 and 98 and then through the discharge apertures 22.

During discharge, atomisation of the discharged suppressant agent takes place, being produced by the kinetic effect of the very high velocity with which the sup-

pressant is discharged.

This high velocity is obtained by the use of a high discharge superpressure. Because of the presence of the piston, which causes the suppressant agent to be rapidly pressurised until the burst discs rupture, the discharged suppressant accelerates extremely rapidly, almost instantaneously, to its discharge velocity, thus optimising atomisation. If all the developing gas pressure were to be applied directly to the suppressant agent, acceleration of the suppressant would be much slower. Atomisation is also assisted by the fact that the suppressant is stored immediately adjacent to the discharge orifices.

In addition, though, some of the hot gas generated by the gas generator 6 is fed directly into the end portion 20 via the tube 104 and the apertures 88 and 96. The hot gas raises the sensible heat of the suppressant agent upon discharge in order to obtain vaporisation of the agent. The rate of direct gas supply through the tube 104 is controlled to the minimum rate necessary to ensure complete vaporisation of the suppressant agent when it is discharged at the lowest expected environmental temperature. The discharge from the nozzle will be in the form of liquid droplets due to the pressure in the nozzle. The combined effects of atomisation and the sensible heat will result in flash vaporisation of the droplets close to the outside of the apertures 22. The suppressant agent is thus first atomised and then vaporised. Vaporisation of the discharging suppressant agent is found to be advantageous because it helps to achieve three dimensional dispersion in a cluttered environment, and thus helps to ensure that the suppressant has access to events which may not be in "line of sight" with the discharging nozzle.

The process of first atomising the suppressant and then vaporising it minimises the amount of heat which is required to obtain flash vaporisation. A significant consequence of this is that the temperature of the vaporised suppressant agent is minimised, thereby preserving the maximum heat abstraction potential per unit mass of the suppressant agent. Heat abstraction is a primary extinguishing mechanism of suitable suppressant agents.

The arrangement illustrated in Figure 1 is advantageous because the amount of gas diverted to the end portion 20 (via tube 104) may be predetermined in order to obtain the desired vaporisation of the suppressant but not to overheat the suppressant.

The burst discs 100 and 102 are arranged to be of suitable material so as to rupture at a predetermined pressure. The discharging suppressant breaks up into droplets so as to enhance the atomization process. A filter positioned across the apertures 22 may be provided to assist the atomisation process. In addition, it acts as a debris screen to prevent discharge of fragments of the burst discs.

Substantially all of the suppressant will be expelled. The pressure generated by the pressure generator 6 may be arranged to rise very rapidly, to the order of 500 psi/mS (3.45MPa/mS).

The burst discs 100,102 may be arranged to burst at, say, 1,200 psi (8.27MPa). Substantially all of the extinguishant may be discharged within less than 70 milliseconds and effective atomisation is achieved.

As shown in Figure 2, which illustrates a modified form of the end portion 20, the holes 22 are shaped so as to direct the discharging suppressant not merely radially but also in directions inclined forwardly and rearwardly of the radial direction. In other words, the suppressant is discharged substantially omni-directionally. The end plate 25 of Figure 1 is replaced by a conical deflector plate 24. The discharge reaction forces substantially cancel.

The apparatus described may be used to discharge the extinguishants disclosed in, and to implement the procedures disclosed in, co-pending published European patent specification No. 0562756.

Because the suppressant is pushed out by a piston, the discharge of the suppressant is independent of attitude (except to the marginal extent where acceleration forces on the piston will have an effect).

In a modification, the heat to be applied to the pressurized suppressant, prior to its discharge, can be applied from another source, that is, not from the pyrotechnic gas generator. Thus, the heat would be applied separately to the end portion 20. Such heat could be applied indirectly to the discharging suppressant within the end portion 20. This effect could be obtained by extending the pipe 104 into the end portion 20 so that it would terminate in a heat exchanger located within the end portion 20. By this means, the heat of the gas would be transferred to the discharging suppressant indirectly. In such arrangements, there is no contact between the suppressant and the high pressure gas.

This is advantageous where the gas generator produces toxic or potentially corrosive substances (e.g. cordite-type gas generators). In another modification, the suppressant could be heated indirectly by suitable means such as by an electric heater, so as for example to be continuously heated.

The whole apparatus 4 can effectively be regarded as a nozzle "unit" which contains the suppressant. Thus, multiple units 4 could be deployed in a large or cluttered environment, each such unit being independent in the sense that it contains its own gas generator. Such multiple units could be connected to a central control unit by individual electrical connections (for activating the individual gas generators) to form a system.

Figure 3 diagrammatically shows a system employing nozzle units 4 distributed within an area to be protected, but in which the individual nozzle units do not have their own integral gas generators 6. Instead, each unit is connected by a pipeline 62 to the output 68 of a gas generator 70. When suppression is to take place, the gas generator 70 is activated (automatically, for example) to generate gas pyrotechnically and the gas is fed via the pipelines 62 to all the nozzle units 4 and ac-

tivates them as described.

The arrangement shown in Figure 3 does not involve pipeline suppressant loss which occurs in known systems in which a plurality of extinguishant discharge heads are fed under pressure from a centralised supply of suppressant. In the nozzle units 4, the suppressant is stored in respective sealed quantities in the units themselves.

A nozzle unit 4 of the form shown in Figure 3 can if desired be used singly, and connected to a gas generator.

In a modification, the interior 56 of the casing 5 (Figure 1) may contain a close-fitting sealed flexible bellows containing the suppressant under pressure. The piston 106 would be omitted. The gas generated by the gas generator 6 would be applied directly to one end of the bellows to compress it and the other end would be held fixed but would incorporate a burst disc corresponding to and operating in the same way by the burst discs 100,102. The portion of the gas supplied by the pipe 104 in Figure 1 for heating the suppressant could be supplied by a pipe running along the outside of the bellows and either inside or outside the casing 5, or a separate supply of heat to the end portion 20 could be provided.

The use of a gas generator within the unit 4 is advantageous, as compared with the use of a stored supply of gas under pressure, in that the superpressure produced by the gas generator is substantially unaffected by temperature; with gas stored under pressure, this is not the case. In addition, the chamber 5 of the apparatus described does not have to meet the pressure fatigue requirements of a normal high pressure storage vessel (which must withstand repeated variations in pressure due to thermal cycles). The chamber 5 of the apparatus described simply has to be able to withstand the superpressure produced by the gas when suppression is to take place, and clearly this only has to be withstood for a relatively short time; the vapour pressure of the suppressant agent itself is very much lower than this superpressure. Therefore, very high levels of superpressure can be used, without the penalty of increasing container weight. Leakage of stored high pressure gas from the nozzle unit is also avoided.

Because the suppressant agent is stored on its own and without any pressurising gas, the status of the suppressant can be determined by a simple weight check.

Claims

1. Apparatus for discharging a fire or explosion suppressant, comprising discharge nozzle means (22), storing means (56) for storing the suppressant juxtaposed with the nozzle means (22), discharge means (6) for applying gas pressure to the stored suppressant without contact between the gas pressure and the suppressant to discharge it through the nozzle means (22), and heating means (104) operative to apply heat to the pressurised suppressant, whereby to cause at least partial vaporisation of the discharged suppressant.

2. Apparatus according to claim 1, characterised by a rupturable barrier (100,102) for blocking the suppressant from the nozzle means (22), the rupturable barrier (100,102) being arranged to rupture when subjected to at least a predetermined pressure.

3. Apparatus according to claim 1, characterised in that the storing means comprises an enclosure (56) for receiving the suppressant, the enclosure being partly defined by movable wall means (106) and including means (100,102) for connecting the interior of the enclosure (56) to the nozzle means (22), when the discharge means (6) applies the gas pressure to the stored suppressant, the discharge means (6) comprising means for applying the gas pressure to the movable wall means (106) from outside the enclosure (56) to move the movable wall means (106) in a direction to force the suppressant through the nozzle means (22).

4. Apparatus according to claim 3, characterised in that the movable wall means (106) is forced to move through a predetermined extent of travel sufficient to discharge substantially all of the suppressant from the enclosure (56).

5. Apparatus according to claim 3 or 4, characterised in that the means for connecting the interior of the enclosure (56) to the nozzle means (22) comprises a barrier (100,102) arranged to rupture when subjected to at least a predetermined pressure.

6. Apparatus according to any preceding claim, characterised in that the discharge means comprises gas generating means (6).

7. Apparatus according to any one of claims 1 to 5, characterised in that the discharge means comprises a source of the gas pressure connected to the storing means (56) by a pipe.

8. Apparatus according to claim 7, characterised in that the source of the gas pressure is gas generating means (70).

9. Apparatus according to any preceding claim, characterised in that the heating means comprises means for applying heat indirectly to the suppressant in the storing means (56).

10. Apparatus according to claim 9, characterised in that the heating means comprises electrical heating means.

11. A plurality of separate apparatuses each according to claim 7 or 8, characterised in that the said source is connected to the storing means of each of them by a respective said pipe (62).

12. Apparatus according to claim 6, characterised in that the discharge means comprises gas generating means (6) for generating high temperature gas under pressure, and in that the heating means comprises gas heating means (104) for heating the pressurised suppressant by using the heat of the high temperature gas.

13. Apparatus according to claim 12, characterised in that the gas heating means comprises bypass means (104) for receiving part, only, of the high temperature gas and feeding it to heat the pressurised suppressant.

14. Apparatus according to claim 13, characterised in that the bypass means (104) feeds the said part of the high temperature gas into contact with the pressurised suppressant.

15. Apparatus according to any one of claims 12,13 and 14, characterised in that the gas generating is pyrotechnic gas generating means (6).

16. Apparatus according to any preceding claim, characterised by a container (5) containing the gas generating means (6), the storing means (56) and the nozzle means (22).

17. Apparatus according to claim 3, characterised by a rigid-walled container having a hollow interior, and in that the said enclosure is defined by a closed flexible bellows mounted in the interior of the container, a portion of the outside of the bellows constituting the movable wall means, the discharge means comprising means applying gas pressure to the said portion of the outside of the bellows and within the hollow interior so as to compress the bellows, the bellows incorporating a wall portion which constitutes the means for connecting the interior of the enclosure to the nozzle means and is arranged to rupture under the pressure developed in the bellows to allow the suppressant to discharge through the nozzle means.

18. Apparatus according to claim 3, characterised by a rigid-walled container (5), a hollow interior (56) and piston means (106) which is sealingly slidable within the hollow interior (56) and which forms the movable wall means, the said enclosure being defined between one face of the piston means (106) and a rupturable barrier (100,102) which is positioned within the container (5) and which constitutes the means for connecting the interior of the enclosure (56) to the nozzle means (22), the discharge means (6) applying the gas pressure to the other face of the piston means (106) so that the piston means (106) moves to compress the suppressant agent within the enclosure (106) until the rupturable barrier (100,102) ruptures whereby the suppressant agent is discharged through the nozzle means (22).

19. Apparatus for discharging a fire or explosion suppression agent, comprising a rigid-walled container (5) having a hollow interior, nozzle means (22) providing a discharge orifice mounted on the container (5), means within the container (5) defining an enclosure (56) therein for receiving the suppressant agent, the means defining the enclosure including a rupturable barrier (100,102) normally blocking the interior (56) of the enclosure from the nozzle means (22), the means defining the enclosure (56) including movable wall means (106) within the enclosure (56), and gas producing means (6) for generating gas pressure within a region of the container (5) separated from the enclosure (56) by the movable wall means (106) whereby the movable wall means (106) moves in response to the gas pressure to compress the suppressant agent within the enclosure (56) until the rupturable barrier (100,102) ruptures and the suppressant agent is forcibly discharged through the nozzle means (22), the movable wall means (106) preventing contact between the gas pressure and the suppressant in the enclosure (56), characterised in that the gas producing means (6) produces gas under pressure and at high temperature, and by means (104) for bypassing the movable means and supplying part, only, of the high temperature gas to the discharging suppressant to heat it.

20. Apparatus according to claim 19, characterised in that the enclosure (56) has at least a portion of constant cross-section, and in that the movable wall means comprises a piston (106) slidable in response to the gas pressure towards the rupturable barrier (100,102) and along the portion of constant cross-section.

21. Apparatus according to claim 19 or 20, characterised in that the bypass means comprises a pipe within the container (5) and sealingly passing through the enclosure (56) and having a first open end (88) outside the enclosure (56) for receiving the said part of the high temperature gas and a second open end (96) open to the nozzle means.

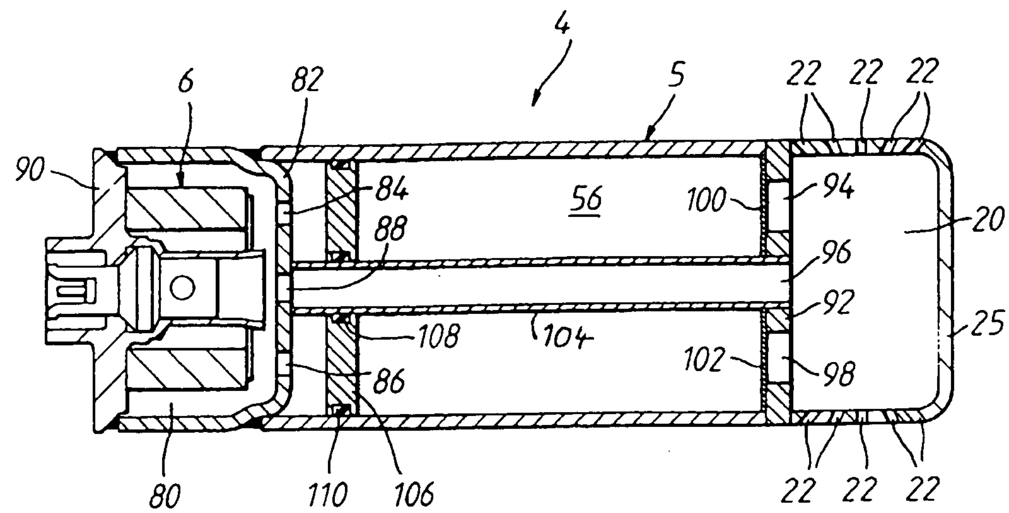

Fig.1

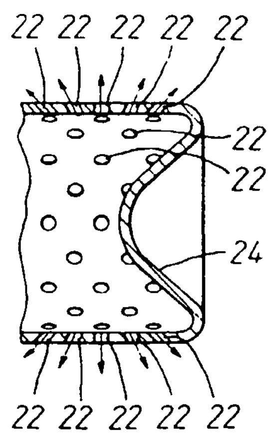

Fig.2

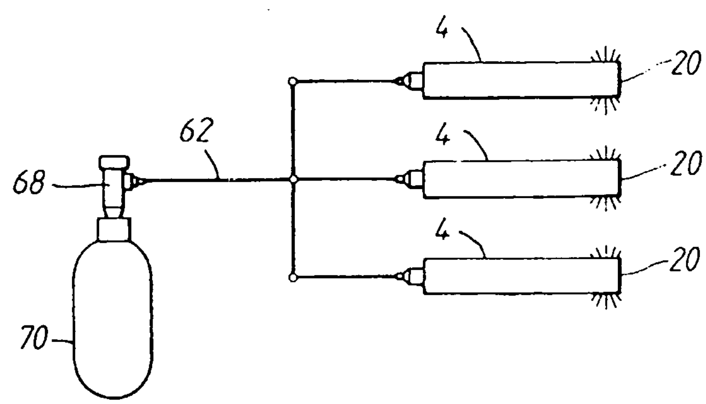

Fig.3

European Patent Office

EUROPEAN SEARCH REPORT

Application Number
EP 96 30 4681

DOCUMENTS CONSIDERED TO BE RELEVANT

Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (Int.Cl.6)
A	DE-A-22 16 178 (DUNN) * page 12, paragraph 2 - page 15, paragraph 2; figures 14-16 * ---	1,19	A62C35/02 A62C13/22
A	US-A-1 660 713 (KAUCH) * column 1, line 32 - column 2, line 80; figures 1,2 * ---	1,19	
A	FR-A-803 340 (PIQUEREZ) * the whole document * ---	1,19	
A	WO-A-94 06515 (ZAKHMATOV) * abstract; figures 2,3 * -----	1,19	

TECHNICAL FIELDS SEARCHED (Int.Cl.6)
A62C
B05B
F41B

The present search report has been drawn up for all claims

Place of search	Date of completion of the search	Examiner
THE HAGUE	27 August 1996	Triantaphillou, P

CATEGORY OF CITED DOCUMENTS

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